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# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No	174-927	Total Pages	29
First Named Inventor or Application Identifier			
MYDLACK et al.			
Express Mail Label No.	N/A		

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for  
Box Patent Application  
Washington, DC 20231

1. ☒ Fee Transmittal Form  
*Submit an original, and a duplicate for fee processing)*
2. ☒ Specification [Total Pages 18]  
*(preferred arrangement set forth below)*  
-Descriptive title of the Invention  
-Cross Reference to Related Applications  
-Statement Regarding Fed sponsored R&D  
-Reference to Microfiche Appendix  
-Background of the Invention  
-Brief Summary of the Invention  
-Brief Description of the Drawings *(if filed)*  
-Detailed Description of the Invention *(including drawings, if filed)*  
-Claim(s)  
-Abstract of the Disclosure
3. ☒ Drawing(s) (35 USC 113) [Total Sheets 9]
4. ☒ Oath or Declaration [Total Sheets 2]
- a. ☒ Newly executed (original or copy)
- b. ☒ Copy from a prior application (37 CFR 1.63(d))  
*(for continuation/divisional with Box 17 completed)*  
**[Note Box 5 below]**
- i. ☐ **DELETION OF INVENTOR(S)**  
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33 (b).
- ☐ Incorporation By Reference *(useable if Box 4b is checked)*  
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Microfiche Computer Program *(Appendix)*
7. ☐ Nucleotide and/or Amino Acid Sequence Submission  
*(if applicable, all necessary)*
- a. ☐ Computer Readable Copy
- b. ☐ Paper Copy *(identical to computer copy)*
- c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney  
*(when there is an assignee)*
10. ☐ English Translation Document *(if applicable)*
11. ☐ Information Disclosure ☐ Copies of IDS  
Statement (IDS)/PTO-1449 Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)  
*(Should be specifically itemized)*
14. ☐ Small Entity ☐ Statement filed in prior application,  
Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)  
*(if foreign priority is claimed)*
16. ☐ Other:

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:  
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: filed.

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ATTORNEY DOCKET NO. 174-927

Date: November 22, 2000

Assistant Commissioner for Patents  
Box PATENT APPLICATION  
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Sir:

The following utility patent application is enclosed for filing:

Applicant(s): MYDLACK et al.

Executed on: November 22, 2000

Title of Invention: METHOD OF MAKING GOLF BALLS

**PATENT APPLICATION FEE VALUE**

TYPE	NO. FILED	LESS	EXTRA	EXTRA RATE	FEE
Total Claims	36	-20	16	\$18.00 each	\$ 288.00
Independent	3	-3	0	\$80.00 each	\$ 0.00
Minimum Fee					\$ 710.00
Multiple Dependency Fee If Applicable (\$270.00)					\$ 0.00
<b>Total</b>					\$ 998.00
50% Reduction for Independent Inventor, Nonprofit Organization or Small Business Concern (a verified statement as to the applicant's status is attached)					\$ 0.00
<b>Total Filing Fee</b>					\$ 998.00

- ☐ Priority of application no. filed on in is claimed under 35 U.S.C. § 119.
- ☐ The certified copy of the priority application has been filed in application no. filed
- ☐ Amend the specification by inserting before the first line the following sentence: This is a continuation-in-part of application no. filed .

enclosed.

Please charge the required fee to Pennie & Edmonds LLP Deposit Account No. 16-1150. A copy of this sheet is

Respectfully submitted,



James G. Markey  
By: Bradley E. Gould  
PENNIE & EDMONDS LLP

Reg. No. 31,636  
Reg. No. 41,792

Enclosure

## METHOD OF MAKING GOLF BALLS

### **TECHNICAL FIELD OF THE INVENTION**

5 The present invention generally relates to golf balls, and more particularly, to a method of making golf balls.

### **BACKGROUND OF THE INVENTION**

Solid golf balls are usually two or more piece constructions. Two-piece golf balls include a single-piece core and a cover. The core forms a golf ball subassembly that the cover surrounds. Three-piece golf balls include a core, an intermediate layer, and a cover. In such balls, the core and intermediate layer form the golf ball subassembly that the cover surrounds.

For a preferred cover the material is a thermosetting polyurethane. One method of making polyurethane-covered golf balls includes disposing the golf ball subassembly into a cover mold and casting the cover thereon. During casting, heat is generated by an exothermic reaction of the thermoset processes. As a result of this heat, the ball subassembly tends to undergo volumetric thermal expansion. Before the cover can sufficiently gel, the thermal expansion of the subassembly can cause the cover to fracture or crack. This is undesirable. In addition, the thermal expansion of the subassembly, can force the cover mold open and cause the subassembly to shift in the mold so that the cover is uneven and has excessive flash. This can result in an unplayable ball.

Prior solid golf balls having cast urethane covers were made using a method that includes preheating the golf ball subassembly to a predetermined elevated temperature. Preheating the subassembly is done to the extent which causes the subassembly to undergo volumetric thermal expansion. Thereafter, the cover is cast onto the subassembly. Preheating decreases the total temperature change the subassembly is exposed to and minimizes the thermal expansion of the subassembly in the cover mold.

There are several drawbacks to this method. First, it requires that the tooling is sized to accommodate expansion due to preheating rather than for the actual subassembly size. This method also requires that the subassembly expands beyond its ambient dimensions. This method also requires that the subassembly go through large extremes of temperature from pre-heating to cooling. In this process, the subassembly is very sensitive to temperature and any differences in temperature can effect the cover properties. Consequently, the golf ball product can vary in size undesirably when it encounters different temperatures.

Similar problems may arise with materials other than thermoset polyurethane using processes other than casting. It is desirable to provide a method of making a golf ball which overcomes these limitations and produces the improved, playable golf balls of the present invention.

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## SUMMARY OF THE INVENTION

The present invention is directed to a method of making a golf ball comprising the steps of cooling a golf ball subassembly such that the golf ball subassembly undergoes a volumetric reduction, and applying a cover layer over the volumetrically reduced golf ball subassembly to form a golf ball.

In one embodiment, the golf ball subassembly includes a core, and in another embodiment the subassembly includes a core and at least one intermediate layer.

In another embodiment, the step of applying the cover layer further includes the steps of providing a first mold half and a second mold half with cavities therein, heating the mold halves to a predetermined temperature, adding a cover material to the first mold half cavity, allowing the cover material to gel, inserting the golf ball subassembly into the first mold half cavity, adding the cover material to the second mold half cavity, and mating the second mold half with the first mold half so that the cover material and the golf ball subassembly are contained within the cavities in the mold halves. In this embodiment, the method can further include curing the cover material after the step of mating the second mold half.

The step of curing the cover material preferably includes the steps of maintaining the mold halves at a first temperature for a first predetermined time, heating the mold halves to a second temperature greater than the first temperature for a second predetermined time, and maintaining the mold halves at a third temperature for a third predetermined time. More preferably, the first step includes bringing the mold halves to the first temperature between about 70°F and about 110°F. The second step includes heating the mold halves to the second temperature greater than about 120°F. The third step includes maintaining the mold halves at the third temperature of between about 70°F and about 110°F. In one embodiment, a cooling step may be required after cooling the cover.

Alternatively, the present invention is directed to a method of curing a golf ball cover as described above.

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## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a golf ball formed according to a method of the present invention;

Fig. 2 is a cross-sectional view of the golf ball of Fig. 1;

5 Fig. 3 is a cross-sectional view of another embodiment of a golf ball formed using the method of the present invention;

Fig. 4 is a flow chart showing the method of making the golf ball according to the present invention;

Fig. 5 is a flow chart showing the details for a step of applying a layer over a golf  
10 ball subassembly in the method shown in Fig. 4;

Fig. 6 is a flow chart showing the details for a step of curing a covered golf ball subassembly in the method shown in Fig. 4;

Fig. 7 is a front, elevational view of a preferred embodiment of a golf ball subassembly alignment device used when covering the subassembly;

15 Fig. 8 is a side elevational view of the alignment device of Fig. 7;

Fig. 9 is a top view of a portion of the alignment device of Fig. 7;

Fig. 10 is a partial, cross-sectional view of an apparatus for mixing a cover material, wherein the apparatus is dispensing the cover material in a lower mold half and an upper mold half is inverted before mating it with the lower mold half;

20 Fig. 11 is a cross-sectional view along line 11--11 of FIG. 7 showing a mold being positioned in the alignment device of Fig. 7; and

Fig. 12 is a schematic representation showing the steps of the method shown in Fig. 4 of applying the cover material, curing the cover material and cooling the ball.

## 25 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1 and 2, a method of the present invention can be used to make a golf ball 10 which comprises a core 12 surrounded by at least one cover layer 14. The cover layer 14 forms the outer surface of the ball 10 and defines dimples 16 therein. In the golf ball 10, the core 12 is the golf ball subassembly S and is of a molded, solid construction.

30 Referring to Fig. 3, the method of the present invention can be used to make a golf ball 20 that includes a core 22 surrounded by at least one intermediate layer 24, which is surrounded by a cover 26. The core 22 and the intermediate layer 24 form the golf ball subassembly S. The cover 26 includes dimples 28.

Although the golf balls 10 and 20 are shown with solid cores 12 and 22,  
35 respectively, the present invention can also be used with fluid-filled cores or wound cores.

The fluid within the core can be a wide variety of materials including air, water solutions, liquids, gels, foams, hot-melts, other fluid materials and combinations thereof, as known by those of ordinary skill in the art.

Referring to Fig. 3, the intermediate layer 24 can be formed by molding  
5 conventional core, mantle layer or cover layer materials on the core 22. The molding techniques used to form the intermediate layer can be those such as injection molding or compression molding. In an alternative embodiment, the ball 20 can be formed with any number of intermediate, core or cover layers formed in any manner. These layers can be solid or wound.

Referring again to Figs. 2 and 3, the covers 14 and 26 should be tough, cut-resistant,  
and selected from conventional materials used as golf ball covers based on the desired performance characteristics. The cover may include one or more layers. Cover materials can be injection moldable, such as ionomer resins, blends of ionomer resins, polyurethane ionomer, thermoplastic urethane, and polyisoprene and blends thereof, as known in the art.  
15 However, in the preferred embodiment, the cover is formed of a thermoset polyurethane, such as a castable polyurethane or a thermoset material that is reaction injection moldable.

Referring to Fig. 4, the method of making golf balls 10 and 20 (as shown in Figs. 2 and 3) according to the present invention generally includes steps 30-40 and will now be discussed. Step 30 includes forming the golf ball subassembly, which includes forming the  
20 core 12 (as shown in Fig. 2) or forming the core 22 and the intermediate layer 24 (as shown in Fig. 3), depending on the construction of the golf ball subassembly.

In more detail, the cores 12 and 22 can be formed by conventional techniques such as disclosed in United States Patent No. 4,389,365 to Kudriavetz, which is incorporated herein by reference in its entirety. Preferably, the cores are formed of compositions having  
25 a rubber base material, an initiator, crosslinking agents, a filler and a co-crosslinking agent. The rubber base material is typically a synthetic rubber like 1,4-polybutadiene having a cis-structure of at least 40%. Natural rubber, polyisoprene rubber and/or styrene-butadiene rubber may optionally be added to the 1,4-polybutadiene. The initiator included in the core composition can be any polymerization initiator which decomposes during the cure cycle.  
30 The crosslinking agents includes a metal salt of an unsaturated fatty acid such as sodium, zinc, lithium or magnesium salt or an unsaturated fatty acid having 3 to 8 carbon atoms such as acrylic or methacrylic acid. Preferably, zinc diacrylate and peroxide are used in these cores. The filler typically includes materials such as zinc oxide, barium sulfate, silica, calcium carbonate, zinc carbonate, regrind, or any powdered metal such as tungsten, and the  
35 like.

Other ingredients such as accelerators, e.g. tetra methylthiuram, processing aids, processing oils, plasticizers, dyes and pigments, as well as other additives well known to one of ordinary skill in the art may also be used in the present invention in amounts sufficient to achieve the purpose for which they are typically used.

5 Generally, all of the ingredients except the initiator are combined. When a set of predetermined conditions is met, i.e., time and temperature of mixing, the initiator is added to the other ingredients in an amount dependent upon the amounts and relative ratios of the starting components, as would be well understood by one of ordinary skill in the art.

After completion of the mixing, the golf ball core composition is milled and hand  
10 prepped or extruded into pieces ("preps") suitable for molding. The milled preps are then compression molded into cores at an elevated temperature. Typically, about 335°F for about 15 minutes is suitable for this purpose.

Other suitable materials for the cores include thermosets, such as rubber, polyisoprene; thermoplastics such as ionomer resins, polyamides or polyesters; or a  
15 thermoplastic elastomer. Suitable thermoplastic elastomers include but are not limited to Pebax®, Hytrel®, thermoplastic urethane, and Kraton®, which are commercially available from Elf-Atochem, DuPont, various manufacturers, and Shell, respectively. Blends of these thermoplastic elastomers can also be used. The core material can also be formed from a castable or reaction injection moldable material. Suitable castable materials include, but are  
20 not limited to urethane, polyurea, epoxy, and silicone. The core can also be fluid-filled center with or without windings or solid-center wound core.

The intermediate layer, if desired, can be formed by joining two hemispherical cups of material in a compression mold or by injection molding, as known by one of ordinary skill in the art. The intermediate layer may be a thermoplastic or a thermoset material. For  
25 example, a recommended ionomer resin material is SURLYN® and a recommended thermoplastic copolyetherester is Hytrel®, which are commercially available from DuPont. Blends of these materials can also be used.

Referring again to Fig. 4, after forming the subassembly in step 30, step 32 includes cooling the golf ball subassembly so that the golf ball subassembly undergoes a volumetric  
30 reduction. Preferably, the subassembly volume after the volumetric reduction is at least about 1% of the golf ball subassembly initial volume.

This cooling step 32 preferably includes disposing the subassembly in a cooling chamber. A recommended cooling chamber would be a commercially available freezer or refrigeration unit capable of achieving the necessary temperatures. Preferably, cooling also  
35 includes decreasing the temperature of the golf ball subassembly to a maximum cooling

temperature of less than about 75°F. More preferably, the maximum cooling temperature is less than about 50°F. More preferably still, the maximum cooling temperature is between about -10°F and about 40°F. Most preferably, the maximum cooling temperature is 20°F. In one embodiment, the maximum cooling temperature can be maintained at room  
5 temperature or about 72°F.

It is recommended that in the cooling step that the golf ball subassembly is maintained at the maximum cooling temperature for greater than 20 minutes. More preferably, the golf ball subassembly is maintained at the maximum cooling temperature for greater than 1 hour. This cooling step occurs before the step of applying the cover layer.

10 With reference to Fig. 4 after cooling step 32, step 34 includes applying a cover layer, such as covers 14 and 26 (shown in Figs. 2 and 3) over the volumetrically reduced or cooled golf ball subassembly. In the preferred embodiment, the cover is cast or reaction injection molded over the subassembly.

Referring to Figs. 4 and 5, when the layer is a cast material the step 34 of applying  
15 the cover layer preferably further includes steps 34a-34g. Step 34a includes providing a first mold half and a second mold half, as discussed in detail below with respect to the equipment used for these steps. The first and second mold halves have cavities therein. Step 34b includes heating or pre-heating the mold halves to a predetermined temperature of between about 100°F and about 150°F. More preferably, the molds are pre-heated to  
20 110°F. Step 34c includes adding a polyurethane cover material to the first mold half cavity. Step 34d includes allowing the cover material to gel. Step 34e includes inserting the cooled golf ball subassembly from step 32 into the first mold half cavity. Step 34f includes adding additional cover material to the second mold half cavity. Step 34g includes mating the second mold half with the first mold half so that the cover material and the golf ball  
25 subassembly are contained within the cavities in the mold halves to form a covered golf ball.

Referring again to Fig. 4 after the cover layer is applied in step 34, the covered golf ball is cured in step 36. Referring to Fig. 6, the step 36 of curing the covered golf ball subassembly and more particularly curing the cover layer 14 or 26 (shown in Figs. 2 and 3)  
30 includes steps 36a-36c. The first curing step 36a includes maintaining the mold halves at a first temperature (T1) for a first predetermined time (t1). The second curing step 36b includes heating the mold halves to a second temperature (T2) greater than the first temperature (T1) for a second predetermined time (t2). The third curing step 36c includes maintaining the mold halves at a third temperature (T3) for a third predetermined time (t3).



It is recommended that the second predetermined time  $t_2$  is less than the first predetermined time ( $t_1$ ) and the third predetermined time ( $t_3$ ).

It is recommended that the first temperature is sufficient to allow the cover material to become plastic (i.e., not flowing). More specifically, it is recommended that the first  
5 temperature is sufficient to allow the cover material to "initially cure." For this specification and the attached claims the term "initially cure" means that the cover material has a low green strength.

Preferably, the first temperature is between about 70°F and about 110°F. The preferred first predetermined time is between about 2 minutes and about 20 minutes. Most  
10 preferably, the first temperature is between about 70°F and about 90°F and the first predetermined time is between about 5 minutes and about 10 minutes.

It is recommended that the second temperature is sufficient to substantially cure the cover material without significantly heating the golf ball subassembly, which is interior to the cover. Preferably, the second temperature is greater than about 120°F, and more  
15 preferably between about 130°F and about 200°F. The preferred second predetermined time is between about 2 minutes and about 10 minutes. Most preferably, the second temperature is between about 130°F and about 140°F and the second predetermined time is about 5 minutes .

It is recommended that the third temperature is less than the second temperature.  
20 Preferably, the third temperature is between about 70°F and about 110°F. The preferred third predetermined time is between about 5 minutes and about 20 minutes. Most preferably, the third temperature is between about 70°F and about 90°F and the third predetermined time is between about 10 minutes and about 15 minutes.

Turning again to Fig. 4, after the step 36 of curing the covered golf ball  
25 subassembly, the resulting golf ball is cooled in step 38 and then removed from the mold in step 40. The step 38, however, is optional. Whether the ball is cooled after curing depends on the third temperature. In the step 38 of cooling the golf ball, it is recommended that the golf ball is cooled sufficiently to allow it to be removed easily from the mold without any cover material sticking to the mold. Preferably, during the cooling in step 38 the golf ball is  
30 cooled to a fourth temperature lower than the first curing temperature ( $T_1$ ). More preferably, the fourth temperature is between about 50°F and about 70°F, and most preferably about 70°F. This temperature is maintained for a fourth predetermined time from about 5 to about 15 minutes and more preferably for about 10 minutes. This cooling step can be done using a cooling chamber or freezer or by allowing the ball to cool in a

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room temperature environment. After this the ball is removed in step 40, the method steps 30-40 can be repeated to make additional golf balls.

Now, the apparatus used during the step 34 (as shown in Fig. 4) of applying the layer will be discussed. Referring to Fig. 7 in order to form the cover, a centering fixture unit 54 is used. The fixture unit 54 includes box frame 56, stationary central guide mount 58 comprising fixed cylinder 60 and stationary guide block 62. Guide block 62 has two (2) parallel passageways 62a, 62b there through for receiving movable rods 64, 66 in sliding vertical movement.

Referring to Fig. 8, rods 64, 66 are fixed to slide ball cup frame unit 68 through back piece 70. Frame unit 68 includes base plate 72 with a ball cup 74 mounted thereto, central opening 75, and upstanding back plate 76. As shown in Fig. 7, ball cup 74 holds ball subassembly S through reduced pressure (or partial vacuum) in hose 73. As best seen in Fig. 8, back piece 70 is secured to back plate 76.

Each mold half 96, 98 (as shown in Fig. 10) is aligned with respect to the fixture frame base 54b of frame 54 using a horizontal rail alignment unit 100 which includes stationary mount block 102 (as shown in Fig. 11) positioned on fixture base 54b, a raised horizontal cross piece 104 which carries two (2) parallel alignment rails 106, 108 having square cross sections. Rails 106, 108 lie in mold end-to-end indentations 110, 112. Each mold indentation 110 and 112 includes a horizontal wall 114, 116 (as seen in Fig. 7) and a vertical wall 118, 120. Rails 106, 108 have tapered tips 122, 124 to assist in guiding and positioning mold halves 96, as each is slid in direction D to the position of Fig. 11. As a mold half 96 is moved back against block 102, it is aligned and the mold half 96 is thereafter accurately positioned as pins 125a and 125b (as shown in Fig. 9) engage and move, as necessary, during fixture descent. The spacings between block 102 and rails 106, 108 and mold 96 are exaggerated in FIG. 11. These tolerances are small enough to achieve the necessary centering tolerances.

Vertical position of subassembly S in ball cup 74 is accomplished using machined collars 126, 128 which slip over pins 125a, 125b as shown in Fig. 8. Set screws 130 are used to hold collars 126, 128. The length of collars 126, 128 determines the distance between cup plate 72 and mold halves 96, 98 and thereafter the position of subassembly S in cup 74.

As shown in Fig. 9, cup 74 (shown in phantom) is not adjustable in this embodiment but is held in fixed relationship to plate 72 with fasteners 132a-c. In another embodiment, the cup 74 can be adjustable with respect to plate 72 by defining elongated slots in the plate in which screws can move to change the position of the cup 74.

Although the apparatus in Fig. 7 is shown to hold one mold half, the apparatus can be configured to hold a number of mold halves simultaneously.

The cover material used in the present method is polyurethane which is the product of a reaction between a polyurethane prepolymer and a curing agent. The polyurethane  
5 prepolymer is a product formed by a reaction between a polyol and a diisocyanate. The curing agent is either a polyamine or glycol. A catalyst may be employed to promote the reaction between the curing agent and the polyurethane prepolymer.

Suitable polyurethane prepolymers for use in the present invention are made from a polyol, such as polyether, polyester or polylactone, and a diisocyanate. Suitable  
10 diisocyanates for use in the present invention include 4,4'-diphenylmethane diisocyanate (MDI) and 3,3'-dimethyl-4,4'-biphenylene diisocyanate (TODI), toluene diisocyanate (TDI), and para-phenylene diisocyanate. The present invention is not limited to the materials listed above and others can also be used.

Suitable polyether polyols include polytetramethylene ether glycol;  
15 poly(oxypropylene) glycol; and polybutadiene glycol. Suitable polyester polyols include polyethylene adipate glycol; polyethylene propylene adipate glycol; and polybutylene adipate glycol.

Suitable polylactone polyols include diethylene glycol initiated caprolactone; 1,4-butanediol initiated caprolactone; trimethylol propane initiated caprolactone; and  
20 neopentyl glycol initiated caprolactone. The preferred polyols are polytetramethylene ether glycol; polyethylene adipate glycol; polybutylene adipate glycol; and diethylene glycol initiated caprolactone.

Suitable curatives for use in the present invention are selected from the slow-reacting polyamine group consisting of 3,5-dimethylthio-2,4-toluenediamine;  
25 3,5-dimethylthio-2,6-toluenediamine; N,N'-dialkyldiamino diphenyl methane; trimethylene-glycol-di-p-aminobenzoate; polytetramethyleneoxide-di-p-aminobenzoate; or a difunctional glycol; and mixtures thereof. 3,5-dimethylthio-2,4-toluenediamine and 3,5-dimethylthio-2,6-toluenediamine are isomers and are sold under the trade name ETHACURE™ 300 by Ethyl Corporation. Trimethylene glycol-di-p-aminobenzoate is sold  
30 under the trade name POLACURE 740M and polytetramethyleneoxide-di-p-aminobenzoates are sold under the trade name Polamine by Polaroid Corporation. N,N'-dialkyldiamino diphenyl methane is sold under the trade name UNILINK™ by UOP.

Suitable difunctional glycols are 1,4-butanediol; 1,3-butanediol; 2,3-butanediol; 2,3-dimethyl-2,3-butanediol; dipropylene glycol; and ethylene glycol. Difunctional glycols are inherently slow-reacting.

To start the cover formation, the prepolymer is preheated and degassed at between  
5 about 140°F and about 160°F and the curative is also preheated and degassed at a  
temperature of between about 140°F and 160°F. As so preheated, the prepolymer and  
curative both have approximately viscosities of 2000 cps. Referring to Fig. 10, metered  
amounts of prepolymer and curative are fed through lines 132 and 134, respectively.  
Mixing of the prepolymer and curative is accomplished in motorized mixer 136 including  
10 mixing head 138 by feeding through lines 132 and 134 of curative and prepolymer. The  
mixer 136 is cooled by cooling jacket 140. Nozzle 142 is connected to mixing head 138 for  
exiting the material.

Due to the exothermic reaction of prepolymer and curative as mixed, the mixing  
head temperature will tend to rise. To control such a rise, the mixing head temperature is  
15 maintained by cooling in a range appropriate for the specific urethane material and to attain  
a workable gel time.

From the time mixing commences until the reacting material is fed into cavity 96a of  
top mold 96 or cavity 98a of bottom mold half 98 is about 4 seconds to about 7 seconds.  
Referring to Fig. 7, top preheated mold half 96 is filled and placed in fixture unit 54 using  
20 pins 125a, 125b moving into holes 94,92 (as shown in Fig. 8). After the reacting materials  
have resided in top mold halves 96 for about 50 seconds to about 80 seconds, subassembly  
S in cup 74 is lowered at a controlled speed into the gelling reacting mixture by lowering  
frame unit 68 using a pneumatic powered arrangement not shown. Alternatively, electric or  
hydraulic systems may be used. Controlled lowering is accomplished by adjustment of the  
25 powered arrangement and by use of pneumatic controls not shown to lessen and preferably  
prevent air bubbles. The collars 126 and 128 limit movement downward of the unit 68.  
The amount of mixture introduced into mold half cavity 96a (as shown in Fig. 10) is about  
5.4 grams to about 5.7 grams.

Upon location of the subassembly S in half mold 96, coating and gelling for 50-80  
30 seconds, the vacuum is released in line 73 allowing subassembly S to be released. Mold  
half 96 with subassembly and gelled or solidified cover half thereon is removed from the  
centering fixture unit 54, inverted (see FIG. 10) and mated with other mold half 98 which, at  
an appropriate time earlier have had a selected quantity of reacting polyurethane prepolymer  
and curing agent introduced therein to commence gelling. The bottom mold half 98 has  
35 similar mixture amounts introduced into its cavity 98a as in cavity 96a. Details with respect

to the timing of this process are disclosed in U.S. Patent No. 6,042,768 to Calabria , et al., which is incorporated herein by reference in its entirety.

After the cover material is applied and the mold halves 96, 98 assembled, the mold halves 96 and 98 are clamped together under between about 400 and about 600 psi pressure.

- 5 These halves are clamped by bolts or any conventional manner. Excess polyurethane is extruded from the mold cavities 96a and 98a into sprues 96b and 98b forming flash on the golf ball cover as discussed below.

Referring to Fig. 12, steps 34-38 of applying the cover material, curing the cover material and cooling the ball are schematically represented. Step 34f includes inserting the  
10 cooled golf ball subassembly S and would use the fixture 54 (as shown in Fig. 7) as described above. Step 34g of mating the mold halves 96 and 98 together is the last step in applying the cover material.

The first curing step 36a of maintaining the mold halves 96, 98 at a first temperature for a first predetermined time is achieved by placing the mold halves 96, 98 and golf ball G  
15 into an insulated chamber 143. This step can also be accomplished by using a cooling chamber. Insulating and cooling chambers are commercially available and capable of maintaining the necessary temperatures.

The second curing step 36b of heating the mold halves 96, 98 to a second temperature is achieved by placing the mold halves 96, 98 and the golf ball G into a curing  
20 oven 144. Curing ovens are commercially available, and a preferred type would be a convection oven capable of achieving the necessary temperatures.

The third curing step 36c of maintaining the mold halves 96, 98 at a third temperature for a third predetermined time is achieved by placing the mold halves 96, 98 and the golf ball G into an insulating chamber 146, similar to chamber 143. This step can  
25 also be accomplished by using a cooling chamber. Insulating and cooling chambers are commercially available and capable of maintaining the necessary temperatures. Mold halves 96, 98 are held together for between about 10 minutes and about 15 minutes then cooled.

Referring to Fig 12, step 38 of cooling the golf ball G is achieved by placing the  
30 mold halves 96, 98 and the golf ball G into a cooling chamber 148. Cooling chambers for use in this step are commercially available.

Referring again to Fig. 4, in step 40 the mold halves 96, 98 are opened and the ball is demolded or removed from the mold using manual or automated techniques as known by those of ordinary skill in the art.

Post-mold finishing can be done to remove any flash and the resulting cover may be between about 20 and about 50 mils thick on a side and have a Shore D hardness of approximately 20 to 60 using ASTM specification or have a Shore D hardness on the ball of about 30 to about 60 when measured after a two-day waiting period. Subsequently, the ball  
5 can be painted and the cover may also be observed to be highly abrasion and cut resistant.

Although in Fig. 10, the mold halves for clarity do not show projections for forming dimples in the cover and the balls are shown without such dimples. The mold halves are formed such that they form dimples in the cover during molding as known by those of ordinary skill in the art.

10 While it is apparent that the illustrative embodiments of the invention disclosed herein fulfill the objectives stated above, it is appreciated that numerous modifications and other embodiments may be devised by those skilled in the art. For example, the golf ball subassembly can be dipped in latex before the cover is applied. In addition, although the present method is disclosed for use with golf balls it can be used to form other objects of  
15 similar materials. Therefore, it will be understood that the appended claims are intended to cover all such modifications and embodiments which would come within the spirit and scope of the present invention.

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## CLAIMS

What is claimed is:

1. A method of making a golf ball comprising:
  - a. cooling a golf ball subassembly such that the golf ball subassembly undergoes a volumetric reduction; and
  - b. applying a cover layer over the volumetrically reduced golf ball subassembly.
2. The method of claim 1, further including the step of forming the golf ball subassembly before the step of cooling, wherein forming the golf ball subassembly includes forming a core.
3. The method of claims 2, wherein the step of forming the core includes compression molding a polybutadiene base material.
4. The method of claim 2, wherein the step of forming the golf ball subassembly further includes forming at least one intermediate layer on the core.
5. The method of claim 4, wherein the step of forming each intermediate layer includes compression molding or injection molding a thermoplastic or thermoset material over the core.
6. The method of claim 1, wherein the step of cooling includes decreasing the temperature of the golf ball subassembly to a cooling temperature of less than about 75 °F.
7. The method of claim 1, wherein the step of cooling includes decreasing the temperature of the golf ball subassembly to a cooling temperature of less than about 50 °F.
8. The method of claim 6, wherein the cooling temperature is between about -10 °F and about 40 °F.

9. The method of claim 7, wherein the step of cooling further includes maintaining the golf ball subassembly at the cooling temperature for greater than 20 minutes before the step of applying the cover layer.

10. The method of claim 7, wherein the step of cooling further includes maintaining the golf ball subassembly at the cooling temperature for greater than 1 hour before the step of applying the cover layer.

11. The method of claim 1, wherein the volumetric reduction is at least about 1%.

12. The method of claim 1, wherein the step of applying the cover layer is a casting process.

13. The method of claim 1, wherein the step of applying the cover layer is a reaction injection molding process.

14. The method of claim 1, wherein the step of applying the cover layer further includes: providing a first mold half and a second mold half, the first and second mold halves have cavities therein;  
heating the mold halves to a predetermined temperature;  
adding a cover material to the first mold half cavity;  
allowing the cover material to gel;  
inserting a golf ball subassembly into the first mold half cavity;  
adding the cover material to the second mold half cavity;  
mating the second mold half with the first mold half so that the cover material and the golf ball subassembly are contained within the cavities in the mold halves.

15. The method of claim 14, further including the step of curing the cover material to form the cover layer after the step of mating the second mold half.



16. The method of claim 15, wherein the step of curing the cover material further includes:

- i. maintaining the mold halves at a first temperature for a first predetermined time;
- ii. heating the mold halves to a second temperature greater than the first predetermined temperature for a second predetermined time; and
- iii. maintaining the mold halves at a third temperature for a third predetermined time.

17. A method of curing a golf ball cover comprising the steps of:

- a. providing a covered golf ball subassembly in two mold halves;
- b. maintaining the mold halves at a first temperature for a first predetermined time;
- c. heating the mold halves to a second temperature greater than the first predetermined temperature for a second predetermined time; and
- d. maintaining the mold halves at a third temperature for a third predetermined time.

18. The method of claim 17, wherein the first temperature has a value sufficient to allow the cover to initially cure.

19. The method of claim 17, wherein the first temperature is between about 70°F and about 110°F.

20. The method of claim 19, wherein the first predetermined time is between about 2 minutes and about 15 minutes.

21. The method of claim 17, wherein the first temperature is between about 70°F and about 90°F and the first predetermined time is between about 5 minutes and about 10 minutes.

22. The method of claim 17, wherein the second temperature is greater than about 120°F.

23. The method of claim 17, wherein the second temperature is between about 130°F and about 170°F.

24. The method of claim 17, wherein the second predetermined time is between about 2 minutes and about 10 minutes.

25. The method of claim 21, wherein the second temperature is between about 130°F and about 140°F and the second predetermined time is between about 3 minutes and about 7 minutes.

26. The method of claim 167, wherein the third temperature is less than the second temperature.

27. The method of claim 17, wherein the third temperature is between about 70°F and about 110°F.

28. The method of claim 17, wherein the third predetermined time is between about 5 minutes and about 15 minutes.

29. The method of claim 25, wherein the third temperature is between about 70°F and about 90°F and the third predetermined time is between about 10 and about 15 minutes.

30. The method of claim 17, wherein the second predetermined time is less than the first predetermined time and the third predetermined time.

31. A method of making a golf ball comprising:

- a. cooling a golf ball subassembly such that the golf ball subassembly undergoes a volumetric reduction;
- b. applying a cover layer in mold halves over the volumetrically reduced golf ball subassembly to form a covered golf ball;
- c. curing the layer including the steps of
  - i. maintaining the mold halves at a first temperature for a first predetermined time;
  - ii. heating the mold halves to a second temperature greater than the first predetermined temperature for a second predetermined time; and

11                               iii.     maintaining the mold halves at a third temperature for a third  
12                               predetermined time.

1       32.     The method of claim 31, wherein the step of maintaining the mold halves at a first  
2       temperature includes placing the mold halves in a first insulating chamber.

1       33.     The method of claim 31, wherein the step of heating the mold halves to a second  
2       temperature includes placing the mold halves in a curing oven.

1       34.     The method of claim 31, wherein the step of maintaining the mold halves at a third  
2       temperature includes placing the mold halves in a second insulating chamber.

1       35.     The method of claim 31, further including the step of cooling the mold halves to a  
2       fourth temperature lower than the third temperature.

1       36.     The method of claim 35, wherein the fourth temperature is between about 60°F and  
2       about 80°F.

## ABSTRACT

5 The present invention is directed to a method of making a golf ball comprising the steps of cooling a golf ball subassembly such that the golf ball subassembly undergoes a volumetric reduction, and applying a cover layer over the volumetrically reduced golf ball subassembly. The method can further include a three-step curing process after applying the cover layer. The three-steps include maintaining mold halves containing the covered subassembly at a first temperature, heating the mold halves to a second temperature, then  
10 maintaining the mold halves at a third temperature. Also, the method can include cooling the golf ball after applying and curing the cover.

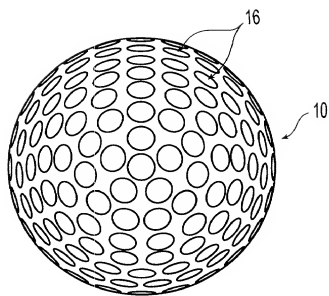


Fig. 1

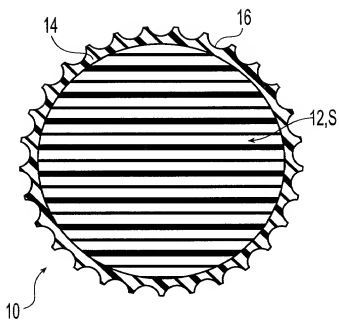


Fig. 2

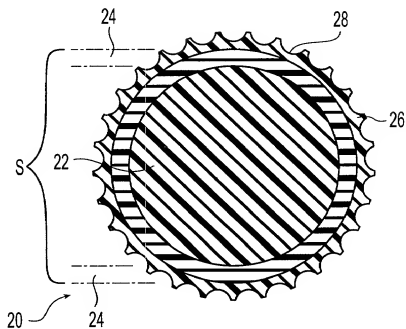
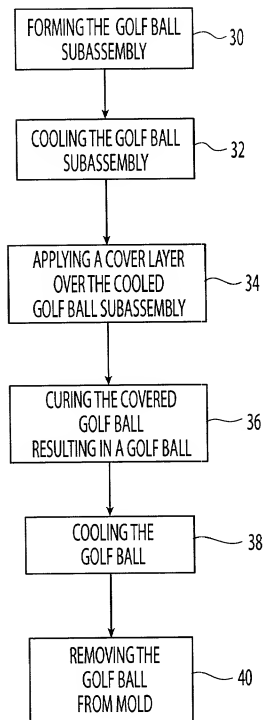


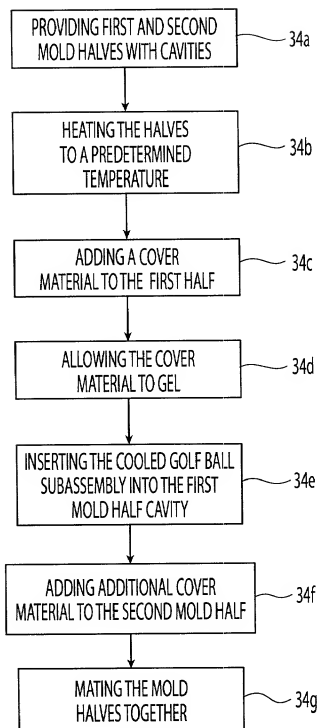
Fig. 3

METHOD FOR MAKING A GOLF BALL



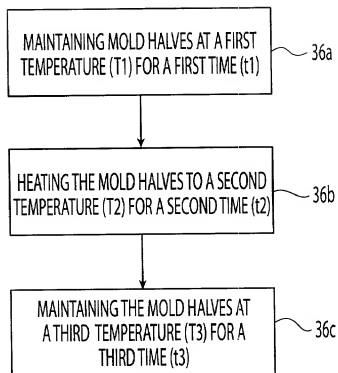
*Fig. 4*

STEP OF APPLYING A COVER LAYER OVER  
GOLF BALL SUBASSEMBLY



*Fig. 5*

CURING STEP

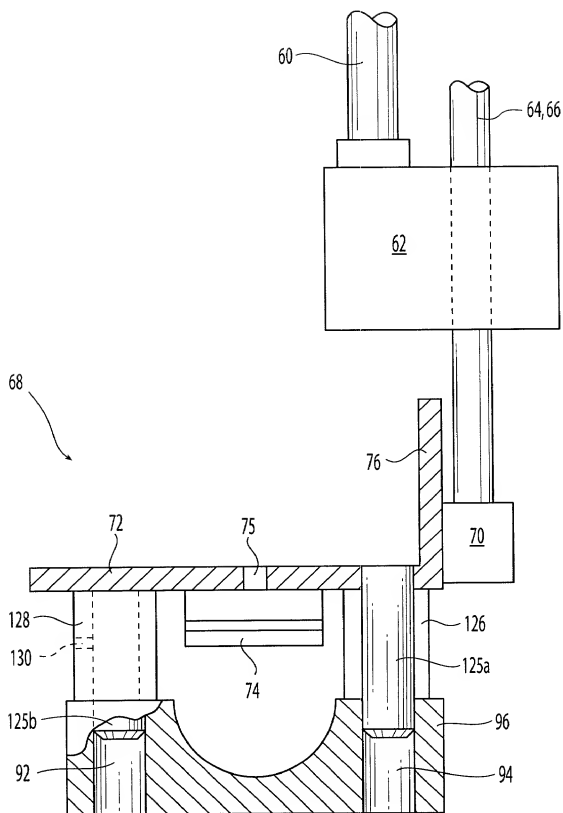


T1 LESS THEN T2  
T3 LESS THAN T2  
t2 LESS THAN t1  
t2 LESS THAN t3

*Fig. 6*







*Fig. 8*

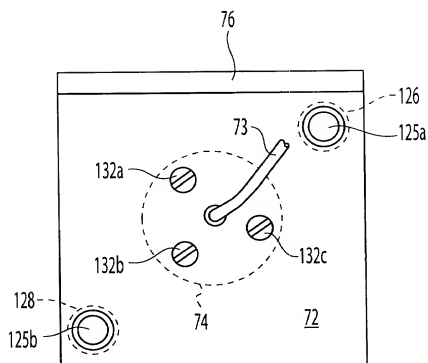


Fig. 9

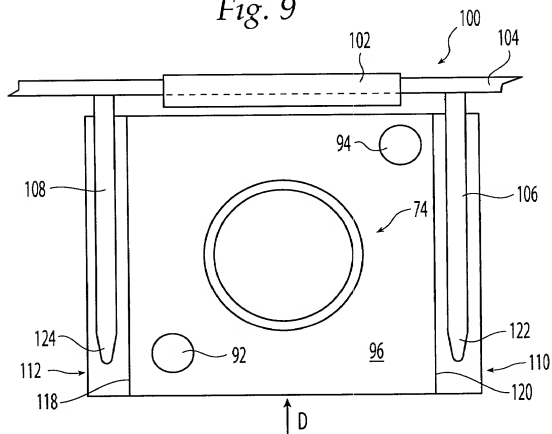


Fig. 11



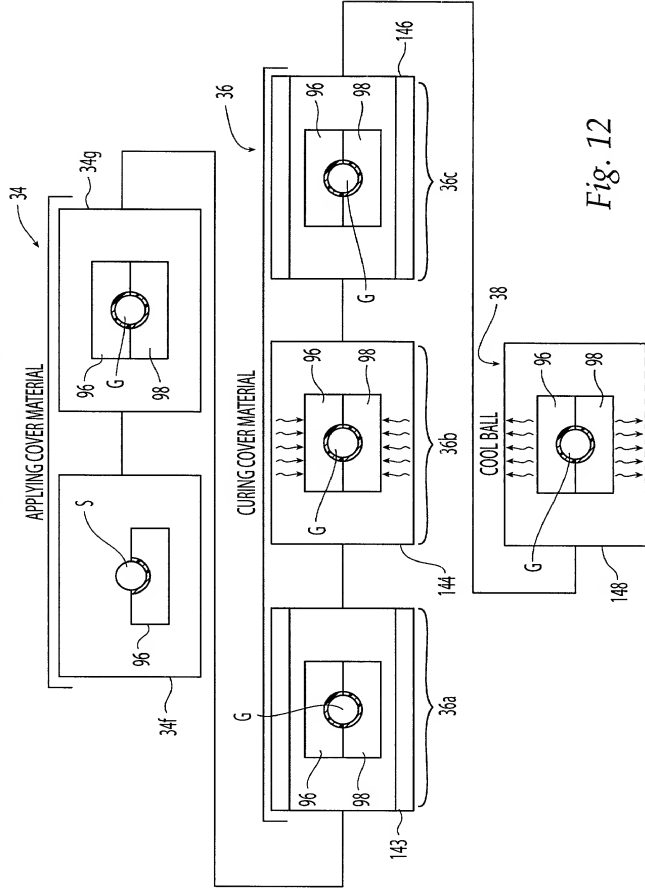


Fig. 12

**DECLARATION FOR NON-PROVISIONAL PATENT APPLICATION\***

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below at 201 et seq. beneath my name.

I believe I am the original, first and sole inventor if only one name is listed at 201 below, or an original, first and joint inventor if plural names are listed at 201 et seq. below, of the subject matter which is claimed and for which a patent is sought on the invention entitled

**METHOD OF MAKING GOLF BALLS**

and for which a patent application:

☒ is attached hereto and includes amendment(s) filed on *(if applicable)*

☐ was filed in the United States on *as Application No. (for decisions not accompanying application)*

with amendment(s) filed on *(if applicable)*

☐ was filed as PCT international Application No. *on* and was amended under PCT Article 19 on *(if applicable)*

I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

EARLIEST FOREIGN APPLICATION(S), IF ANY, FILED PRIOR TO THE FILING DATE OF THE APPLICATION			
APPLICATION NUMBER	COUNTRY	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
			YES <input type="checkbox"/> NO <input type="checkbox"/>
			YES <input type="checkbox"/> NO <input type="checkbox"/>
			YES <input type="checkbox"/> NO <input type="checkbox"/>

I hereby claim the benefit under Title 35, United States Code, §119(a) of any United States provisional application(s) listed below.

PROVISIONAL APPLICATION NUMBER	FILING DATE

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

NON-PROVISIONAL APPLICATION SERIAL NO.	FILING DATE	STATUS		
		PATENTED	PENDING	ABANDONED

\* for use only when the application is assigned to a company, partnership or other organization.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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SIGNATURE OF INVENTOR 205			DATE	

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